ENHANCEMENTS OF CONTINUED FRACTION ABSORBING BOUNDARY CONDITIONS: STRATIFIED MEDIA, BOUNDARIES WITH CORNERS AND TIME DISCRETIZATION ISSUES

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Economic analysis of wave propagation in unbounded domains hinges upon the effectiveness of the artificial boundary conditions in modeling wave radiation into the exterior. Continued fraction absorbing boundary conditions (CFABCs), proposed by Guddati and Tassoulas [1], are found to be effective in absorbing waves impinging at different angles on the computational boundary. Although CFABCs are high-order approximations of exact absorbing boundary condition (DtN map), they contain only second-order derivatives and are amenable to standard finite element implementation. The only uncommon nature of CFABC is that the spatial discretization of the coupled interior-exterior problem results in a system of third-order differential equations in time, which is uncharacteristic of standard wave propagation problems.

The original CFABC formulation is limited to straight computational boundaries and to homogeneous media. Furthermore, no attention had been given to the choice of time discretization of the third-order differential equations and associated stability and accuracy properties.

Recently, based on the ideas related to optimal discretization of perfectly matched layers [2], we have extended the CFABCs to the more general cases of stratified media as well as media with orthogonal and non-orthogonal corners [3]. Various schemes of time stepping are considered for discretizing the unconventional third-order evolution equations, and their stability and accuracy properties are analyzed [4].

In this presentation, the above-mentioned developments of continued fraction absorbing boundary conditions will be discussed. Numerical examples will be presented not only to illustrate the superior performance of the new CFABCs, but also to verify the stability and accuracy properties of the time-stepping techniques. Numerical examples will also be used to illustrate the economical nature of CFABCs in comparison with standard discretization of perfectly matched layers.

References

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